

SELECTED AGRO-CLIMATIC CHARACTERISTICS AND WINE-GRAPE YIELDS IN THE SOUTHERN MORAVIA

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Abstract

The sums of average daily temperatures higher than 10 °C (TS10) in the period from April to September describe the temperature conditions in the given area. The absolute precipitation sums concerning the season, i.e. from April to September, and the Seljaninov's Hydrothermal Coefficient (HTC) during the period from June to August describe precipitation and moisture conditions. The HTC values confirm the fact that the South Moravian region belongs among the most arid regions in the Czech Republic. The attention is, also, devoted to connections between the wine-grape yield and the weather conditions in 1997, an abnormal year from the meteorological point of view.

Key words: winegrowing, temperature sum, precipitation sum, Seljaninov's Hydrothermal Coefficient, wine-grape yields, Southern Moravia, decade 1993 – 2002.

NEKATERE AGROKLIMATSKE ZNAČILNOSTI JUŽNE MORAVSKE POMEMBNE ZA VINOGRADNIŠTVO

Izvleček

Razmere, primerne za uspevanje vinske trte, najbolj ponazarja vsota povprečnih dnevnihih temperatur višjih od 10 °C (TS10) v obdobju od aprila do septembra. Padavinske razmere obravnavanega območja v rastni sezoni so predstavljene s pomočjo podatkov o količini padavin, vlažnostne razmere od junija do avgusta pa s pomočjo Seljaninovega hidrotermičnega koeficienta (HTC). Vrednosti HTC potrjujejo znanemu dejstvu, da spada Južna Moravska med najbolj sušna območja na Češkem. Posebna pozornost je v prispevku namenjena tudi vinski letini in vremenskim pogojem v letu 1997, ki je bilo z meteorološkega vidika neobičajno.

Ključne besede: vinogradništvo, temperaturne vsote, količina padavin, Seljaninov hidrotermični koeficient, vinska letina, Južna Moravska, Republika Češka.

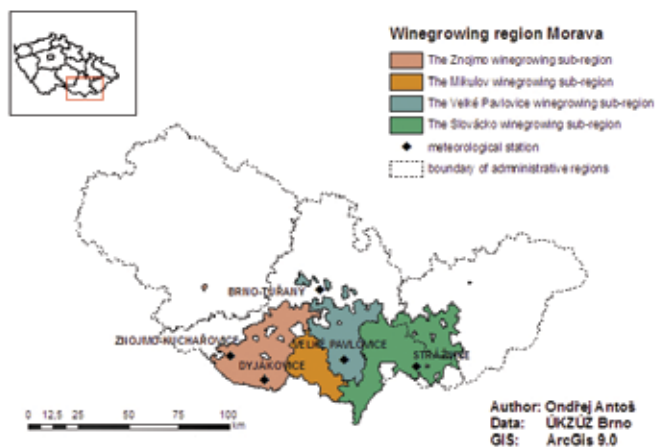
I. INTRODUCTION

This article presents the results of the dissertation called “The agro-climatic conditions of winegrowing in the area of Southern Moravia” (elaborated in cooperation with the Department of Geography, Natural Science Faculty, Palacky University in Olomouc, Czech Republic). The main part of this dissertation is the analysis of the agro-climatic conditions in chosen locations during the 1993 – 2002 decade.

2. METHODS AND DATA

The author deals with meteorological characteristics in the period of time from 1993 to 2002. For such an analysis two main criteria were taken into consideration: air temperature and precipitation sums. These characteristics were elaborated for selected meteorological stations in the Southern Moravia: Znojmo – Kuchařovice, Dyjčkovice, Brno – Tuřany, Velké Pavlovice and Strážnice. These stations are perceived as representatives of “Morava” winegrowing region in the Southern Moravia (Fig. 2.1.). It is necessary to say that the station situated in Mikulov winegrowing sub-region is not included in this paper. Due to the short span of time (mainly concerning the data set), trend and variability were not researched. In some years the connections between wine-grape yield (an agricultural product typical of the Southern Moravia) and the course of meteorological elements have been discussed.

Figure 1: Winegrowing region Morava according to Regulation No 324/2004 Coll.



Statistical data concerning yield values were provided by Central Institute for Supervising and Testing in Agriculture (ÚKZÚZ), the Division of Perennial Plants. Meteorological data were provided by Czech Hydrometeorological Institute (ČHMÚ) in Brno.

Table 1: Selected meteorological stations in the area of Southern Moravia (ČHMÚ, 2003)

Name of station	Elevation (m)	Geographical location
Znojmo - Kuchařovice	334	48° 52' 57" N, 16° 05' 11" E
Dyjákovice	201	48° 46' 24" N, 16° 17' 51" E
Brno - Tuřany	241	49° 09' 35" N, 16° 41' 44" E
Velké Pavlovice	196	48° 53' 57" N, 16° 49' 28" E
Strážnice na Moravě	176	48° 46' 24" N, 17° 20' 17" E

All computations, tables and graphs were created using Microsoft Excel tools, maps were created in ArcGIS 9.0.

3. TEMPERATURE CONDITIONS

Air temperature is the determinative factor for winegrowing. In the Table 3.1., the value sums of average daily temperatures higher than 10 °C (further as TS10) in the period from April to September 1993–2002 are shown. TS10 reaches 2200 °C (for the earliest cultivars) and about 3000 °C (for very late cultivars) in the Czech Republic. However, TS10 in southern winegrowing regions is frequently higher, e.g. in South African Republic 6000 °C. The growing season in northern winegrowing regions (also in the Czech Republic) is reduced using early and semi-early cultivars, so under the same conditions we get better quality wine.

Table 2: Temperature sums TS10 during IV-IX (°C) in selected stations in Southern Moravia in 1993-2002

Station / Year	1993	1994	1995	1996	1997	1998
Velké Pavlovice	2845.1	3068.3	2843	2714.7	2785.5	3022.4
Brno - Tuřany	2806.3	2995.3	2776.9	2541.7	2667.8	2885.6
Strážnice	2795.7	2922.2	2719.8	2554.7	2571.9	2910.2
Kuchařovice	2694.5	2870.1	2641.3	2351	2539.9	2720.8
Dyjákovice	2881.8	3021.8	2869.1	2652.7	2756.1	2976.5
Average	2804.68	2975.54	2770.02	2562.96	2664.24	2903.1

Station / Year	1999	2000	2001	2002	1993-2002
Velké Pavlovice	3104.4	3149.2	2784.3	2993.7	2931.06
Brno - Tuřany	3014.5	3078.7	2712.7	2936.3	2841.58
Strážnice	2898.2	2936.4	2657.1	2847.2	2781.34
Kuchařovice	2793.4	2900.7	2592.9	2847.7	2695.23
Dyjákovice	3019.4	3112.2	2830.9	2999.1	2911.96
Average	2965.98	3035.44	2715.58	2924.8	2832.234

The Znojmo winegrowing sub-region has a really good net of meteorological stations. Each of the stations (Kuchařovice, Dyjákovice) measured quite different values. The

Dyjákovice station measured the highest values (which were as high as over 3000 °C – in 1994, 1999, 2000). On the other hand, Kuchařovice was the coldest meteorological station in the decade. In the coldest year of the decade (1996), TS10 reached only 2351 °C.

From the Table 3.1., we can see that in Velké Pavlovice locality highest values were reached in 1993-2002. The values over 3000 °C occurred four times. Even in the coldest year of the decade (1996) TS10 was still over 2700 °C.

4. PRECIPITATION SUMS AND MOISTURE CONDITIONS

In this chapter an attention has been devoted to two parameters: Absolute sums of precipitation in the period from April to September and the Seljaninov's Hydrothermal Coefficient.

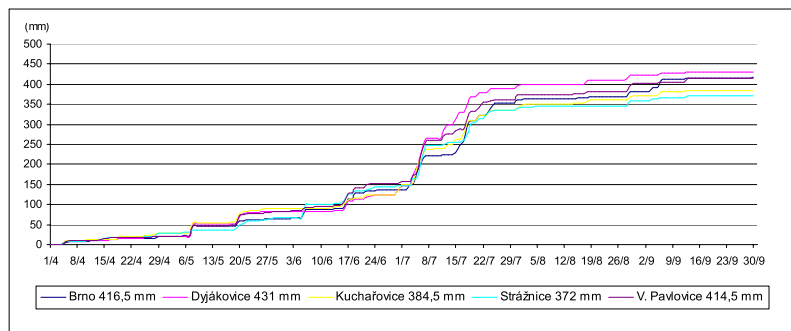
4.1 Precipitation

Precipitation sum belongs among other agro-climatic characteristics that affect wine-growing. For winegrowing, especially seasonable precipitation during the whole growing season is important.

Table 3: Absolute precipitation sums (mm) in selected stations in the period IV – IX in the decade 1993 – 2002

Station / Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	93-02
Velké Pavlovice	285.9	265.4	466.8	361.3	414.5	374.0	334.2	283.5	389.3	360.6	353.6
Brno - Tuřany	290.0	310.1	365.2	354.6	416.5	383.1	306.8	245.6	408.5	344.5	342.5
Strážnice	244.1	343.1	344.0	378.9	372.4	350.9	327.9	283.4	353.6	301.9	330.0
Kuchařovice	295.4	252.4	429.6	411.4	384.5	320.8	356.4	297.2	314.5	471.9	353.4
Dyjákovice	312.3	235.4	434.7	363.8	431.0	302.1	364.0	250.2	333.5	392.7	342.0
average	285.5	281.3	408.1	374.0	403.8	346.2	337.9	272.0	359.9	374.3	344.3

Figure 3: Absolute precipitation sums (mm), April – September 1997 in selected stations in the Southern Moravia



In the decade 1993-2002 we may notice the abnormal character of the year 1997. The Figure 4.1.1. shows the distribution of precipitation sums during the season from April to September in the 1997. It is evident that the precipitation sums were evenly placed until June and did not reach extremes. However, after that (from the first decade of July on) it rained a lot during a very short period of time. The rainy period lasted for approximately 14 days. There was almost no precipitation in August. Its possible consequences for wine-grape yield are discussed in the chapter 5.

4.2 Moisture conditions

Under the term – moisture conditions we understand the amount of available water in the soil (Dobrovolný 1996, p. 188). The relation between precipitation and potential evaporation denote the Seljaninov's Hydrothermal Coefficient (further HTC) which can be expressed by the following relation:

$$HTC = \frac{R}{0,1 \sum t}$$

where R ... absolute precipitation sum during summer months (VI – VIII)

$\sum t$... the sum of average daily temperatures 10 °C or higher during summer months (VI – VIII)

The significant value for HTC is 1. The areas with $HTC < 1$ (in the long-term perspective) are called as “arid” and the areas with $HTC > 1$ as “humid”. The next table shows the values of HTC at selected stations in the Southern Moravia in the 1993 – 2002.

Table 4: Seljaninov's Hydrothermal Coefficient, from June to August, 1993 – 2002, selected stations in the Southern Moravia

Station/year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	AVERAGE
Brno-Tuřany	1.27	0.73	0.95	1.19	1.83	1.12	1.11	0.99	1.14	1.24	1.16
Dyjákovice	1.12	0.60	1.18	1.29	1.94	0.83	1.40	0.87	0.62	1.51	1.14
Kuchařovice	1.05	0.39	1.30	1.38	1.68	0.93	1.40	1.22	0.94	1.72	1.20
Strážnice	1.10	0.84	1.08	1.08	1.74	1.03	1.34	1.07	0.98	1.22	1.15
Velké Pavlovice	1.19	0.72	1.47	1.01	1.80	1.06	1.25	1.14	1.23	1.44	1.23
AVERAGE	1.15	0.66	1.20	1.19	1.80	0.99	1.30	1.06	0.98	1.43	1.17

The average values (in the decade 1993-2002) of HTC confirm the fact that Southern Moravia region belongs among the most arid regions in the Czech Republic. (Detailed comparison by means of HTC for the whole Czech Republic was elaborated by Dobrovolný 1996). The high values of HTC in 1997 correspond to the distribution of precipitation sums during the season (April – September).

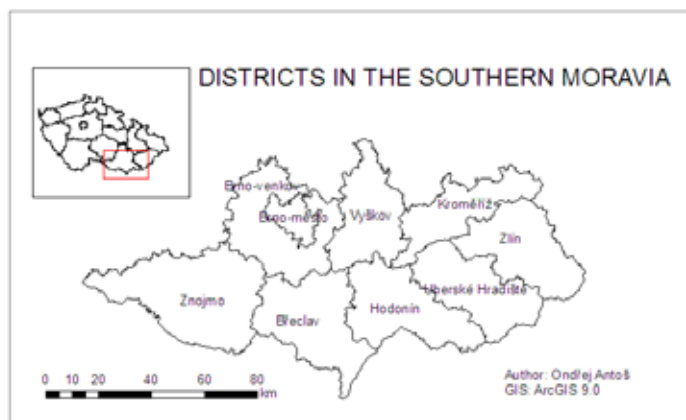
5. WINE-GRAPE YIELDS DURING 1993 – 2002

Every year the agricultural crop yield serves us as one of the quality indicators. In the next table, there are shown the wine-grape yields during 1993-2002. (The values are calculated for the administrative units – Brno city districts, Brno – the City, Břeclav, Hodonín, Uherské Hradiště, Znojmo, Vyškov and Kroměříž – Fig. 5)

Table 5: Wine-grape yield (t/ha) in the districts of Southern Moravia (by ÚKZUZ Brno)

District/year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Brno	4,17	5,70	3,86	5,59	3,23	4,64	6,75	4,47	4,62	4,90
Břeclav	4,97	6,13	4,36	6,14	3,50	5,75	6,44	5,83	6,13	5,53
Hodonín	6,32	6,00	3,85	7,02	4,23	4,96	6,83	7,30	7,38	5,10
Kroměříž, Zlín, Vyškov	6,18	2,3	1,26	3,63	2,39	3,62	4,50	7,32	9,00	4,30
Uh. Hradiště	5,81	4,72	4,07	5,28	3,63	4,49	5,02	6,34	6,49	4,80
Znojmo	4,86	6,76	3,67	5,62	1,21	4,09	4,95	5,06	5,02	5,20
Total South Moravia	5,34	6,13	4,00	6,18	3,20	4,99	6,11	6,03	6,15	5,28

Figure 4: Administrative districts in the Southern Moravia

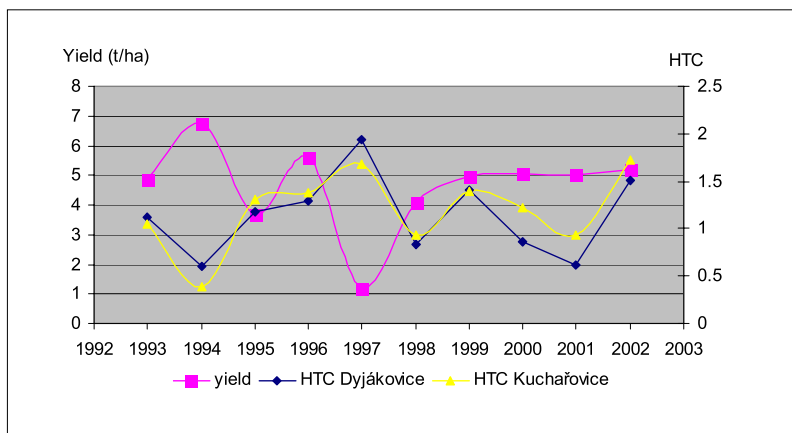


It is obvious that the yields differed a lot in the course of the 1993-2002 decade. The lowest values occurred in 1997. The main cause of this fact were extremely low temperatures during winter 1996/1997 when the vineyards were damaged by frost. The next important reason was the course of meteorological elements during growing season. The distribution of precipitation in the period from April to September was described in the chapter 4.1. The

vegetative course of grapevine was normal until the flowerage. Frequent rainy periods caused bad blooming of grapevine in the second half of June. As a result the yields dropped off again. High precipitation sums caused an occurrence of Downy mildew of grapevine (*Plasmopara viticola*) in July. Mainly leaves and grapes were harmed. On the other hand, the precipitation did not practically occur in the second half of August (during the phenological stage called softening of berries) and the highest daily temperature reached the values over 30 °C. The course of meteorological elements was positive during the phenological stage of ripening. In this year it was one of the best quality harvest though being the lowest on the other hand. (The sugar content was very high, yield very low).

The development of HTC (Kuchařovice and Dyjácovice stations) and wine-grape yields (Znojmo district) is shown in the next figure for comparison.

Figure 5: Wine-grape yields (t/ha, Znojmo district) and HTC in the course of summer months (Kuchařovice and Dyjácovice stations) during the 1993-2002 period



An enormous difference between the both characteristics in 1997 is obvious. On the other hand, the values of HTC were almost equal in 2002 but the yield, in this very year, did not drop off. It indicates that a suitable distribution of precipitation is more important for grapevine (during growing season) than the absolute sum of precipitation.

6. CONCLUSION

The author has placed special emphasis on the behaviour of the two most important meteorological factors concerning winegrowing – temperature and precipitation. The temperature characteristics in each of the Moravian winegrowing sub-regions differ a lot. The warmest locality (out of all selected stations) seems to be Velké Pavlovice where TS10 did not drop under 2700 °C in the chosen decade. The lowest values were measured at the

Kuchařovice station (average TS10 was 2695.23 °C in the decade).

Precipitation and moisture conditions were described by means of absolute precipitation sums during the season (i.e. from April to September) and the Seljaninov's Hydrothermal Coefficient during the period from June to August. The values of HTC confirm the fact that the South Moravian region belongs among the most arid regions in the Czech Republic. The connections between wine-grape yield and the course of meteorological elements were discussed in the respect of the abnormal year 1997. The distribution of precipitation in the second half of June and in July was one of the main causes of the low yield in this year.

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NEKATERE AGROKLIMATSKE ZNAČILNOSTI JUŽNE MORAVSKE (REPUBLIKA ČEŠKA) V OBDOBJU 1993-2002 POMEMBNE ZA VINOGRADNIŠTVO

Povzetek

V prispevku so analizirane nekatere temperaturne in padavinske poteze Južne Moravske, ki so pomembne za uspevanje vinske trte. Analiza temelji na podatkih za pet reprezentativnih meteoroloških postaj v obdobju 1993-2002. Pri temperaturah je poudarek na analizi vsot povprečnih dnevnihih temperatur višjih od 10 OC (TS 10) v obdobju april-september. Razmere glede teh vsot se v obravnavani pokrajini precej razlikujejo. Najugodnejše razmere so okoli

Velkih Pavlovic, kjer so vrednosti TS 10 večinoma nad 3000 0C. Najnižje vrednosti so v okolici Kucharovic, kjer je TS 10 v povprečju pod 2700 0C. Tudi najvišje vrednosti TS 10 0C na Moravskem so precej nižje od vrednosti v južnejših vinorodnih območjih, zato v severno ležečih, kamor se uvršča tudi Češka, za zagotovitev boljše kvalitete vin sadijo predvsem bolj zgodnje sorte trt.

Vlažnosti pogoji za uspevanje vinske trte so predstavljeni s količino padavin v rastnem obdobju (april-september) in s Seljaninovim hidrotermičnim koeficientom (HTC). Glede HTC ima Moravska še vedno humidno podnebje (HTC je nad 1), vendar sodi med najmanj namočene pokrajine Republike Češke. Temperaturni in padavinski pogoji so na splošno ugodni za gojenje vinske trte, vendar pridelek grozdja zaradi vremenskih razmer v posameznih letih zelo niha, prav tako tudi kvaliteta vin. Kot primer leta z netipičnim potekom vremena in posledicami le-tega za vinogradništvo, je predstavljeno leto 1997, ko je bil pridelek grozdja najnižji v obravnavanem obdobju. Skromen pridelek je bil posledica zimske pozebe, deževnega vremena v času cvetenja vinske trte, vlažnega vremena in z njim povezanimi boleznimi vinske trte v visokem poletju ter suše v drugi polovici poletja. Kljub količinsko skromni letini pa je bila kvaliteta vin zelo visoka, saj je bilo vreme v času zorenja grozdja zelo ugodno.